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Permanent Forestry and Operational Improvements Cost-Benefit Analysis

Ministry for Primary Industries

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Executive summary

The Government is proposing to make a series of improvements to New Zealand's Emissions Trading Scheme (ETS), including how it operates for ETS forestry participants (the Forestry Package). The Forestry Package consists of three key changes:

1 changing how ETS participants with rotational forests receive carbon credits (NZUs), including options to introduce averaging and harvested wood products

2 introducing a dedicated "permanent post-1989 forest" activity to the ETS and disestablishing the Permanent Forest Sink Initiative (PSFI) from the Forests Act 1949

3 incorporating a suite of operational improvements into the ETS for forestry.

Officials are currently developing final policy recommendations to go to Cabinet before a bill is introduced to Parliament in the middle of 2019.

This report was commissioned by Spatial, Forests and Land Management of Te Uru Rakau, Ministry for Primary Industries (MPI), and provides scenario analysis for a paper that MPI is drafting. The paper is intended to provide a detailed policy design of the Forestry Package. This includes design of policy towards permanent forest activity, operational improvements linked to averaging, and any new operational issues raised from the consultation period.

PwC analysed several scenarios using a cost-benefit analysis (CBA) model, to provide the Ministry with information on possible impacts. The scenarios show the sensitivity of the CBA to key variables. The sensitivities are measured with reference to a baseline set of impacts provided by MPI. Table 1 shows the impacts to the Government and land owners under each scenario and their difference to the baseline.

The results show that:

- land-use decisions are affected by policy
- the proposed policy change is not the only driver of value for forestry participants
- the net benefits of the policy are sensitive to the drivers of carbon earnings and the opportunity cost of establishing and keeping permanent forestry.

Table 1. Government and land-owner ongoing impacts under each scenario ($ per year, nominal)

	Permanent forestry		Operational changes	
Scenarios	**Proposed policy**	**Difference from baseline**	**Proposed policy**	**Difference from baseline**
1. Baseline				
Land-owner net benefits	9,649,000		31,663,110	
Government costs	30,700		246,500	
2. Different policy packages				
Land-owner net benefits	9,649,000	-	31,675,000	11,890
Government costs	30,700	-	87,000	-159,500
3. Status quo behaviour				
Land-owner net benefits	9,649,000	-	8,290,000	-23,373,110
Government costs	30,700	-	125,635	-120,865
4. Six per cent discount rate				
Land-owner net benefits	17,829,000	8,180,000	31,663,110	-
Government costs	30,700	-	246,500	-
5. Reduced sequestration 1				
Land-owner net benefits	8,871,000	-778,000	31,663,110	-
Government costs	30,700	-	246,500	-
6. Reduced sequestration 2				
Land-owner net benefits	9,363,000	-286,000	31,663,110	-
Government costs	30,700	-	246,500	-
7. High carbon price path				
Land-owner net benefits	15,602,000	5,953,000	31,663,110	-
Government costs	30,700	-	246,500	-
8. Low carbon price path				
Land-owner net benefits	2,895,000	-6,754,000	31,663,110	-
Government costs	30,700	-	246,500	-
9. Increased activity				
Land-owner net benefits	19,298,000	9,649,000	51,730,110	20,067,000
Government costs	61,400	30,700	246,500	-

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Introduction

Background

The Government is proposing to make a series of improvements to the ETS, including how it operates for ETS forestry participants (the Forestry Package). The Forestry Package consists of three key changes, including:

1 changing how ETS participants with rotational forests receive carbon credits (NZUs), including options to introduce averaging and harvested wood products (HWPs)

2 introducing a dedicated "permanent post-1989 forest" activity to the ETS and disestablishing the Permanent Forest Sink Initiative (PSFI) from the Forests Act 1949

3 incorporating a suite of operational improvements into the ETS for forestry.

Officials are currently developing final policy recommendations to go to Cabinet before a bill is introduced to Parliament in the middle of 2019.

Scope

MPI has requested PwC provide support for the decisions around parts 2 and 3 of the Forestry Package, described above. The support includes providing:

- a framework to model the costs and benefits of the Forestry Package
- an initial assessment of the information provided by MPI, as it fits into the framework, to enable MPI to write a policy paper in November 2018 on standalone operational improvements and the 'scene-setting' decisions for permanent forests activity
- assistance as needed for a later paper between February and March 2019 on any operational improvements not addressed in the December paper, and minor details of permanent post-1989 forest activity.

Out of scope for this engagement were consideration of the average carbon stock accounting treatment of forests (averaging) and accounting for HWPs.

Purpose

We have undertaken the initial assessment of the costs and benefits (together, the impacts) of the expected changes proposed by MPI. We assessed the impacts on the Government and forestry participants from parts 2 and 3 of the Forestry Package. These initial results presented:

- both upfront and annual ongoing impacts
- both Government and land-owner impacts
- status quo, proposed policy impacts and net expected change.

The purpose of this report is to provide scenario analysis of different variants of the proposed policy initiative and other key variables that underpin the cost borne by the Government and the net benefits realised by land owners. This information will allow MPI and decision-makers to understand the costs of different policy options and the benefits under different assumptions about carbon sequestration and its returns.

Please note, this report is issued pursuant to the Consultancy Services Order signed 7 November 2018 between PwC and MPI and the Restrictions in Appendix C of this report.

Scenario analysis

Scenarios have been provided by MPI, for a later paper between February and March 2019, on the design details of permanent forest activity, operational improvements linked to averaging, and any new operational issues raised from the consultation period. The scenarios did not include average carbon stock accounting treatment of forests or accounting for HWPs.

Although the proposed policies have several components, they are treated as a single package. In the following tables, the key result is the net benefit from the expected change, which is the bottom right-hand entry in each table.

The remaining sections of this report present a set of scenarios to understand the sensitivity of key variables in the cost-benefit analysis. The sensitivities are provided with reference to a baseline set of impacts provided by MPI. The scenarios are as follows:

1 **Baseline** – The baseline scenario assesses the impacts of all policy initiatives proposed by MPI in parts 2 and 3 of the Forestry Package. MPI's impacts and assumptions are described in more detail in Appendix A.

All subsequent scenarios are movements away from the baseline:

Policy scenarios

2 **Different policy package** – This scenario assesses the impacts to the Government and land owners without minor and technical policy operational improvements.

3 **Status quo behaviour** – MPI expects increase rates of uptake (activity rate) into the ETS by forestry participants. This scenario assesses the impacts if the activity rate is the same as that currently observed in the existing policy setting.

4 **Six per cent discount rate** – the default discount rate used in the baseline is eight per cent. This scenario assesses the net incremental benefit to land owners of converting land to permanent forestry with a discount rate of six per cent.

Environmental scenarios

5 **Reduced carbon sequestration (50 per cent)** – this scenario assesses the reduction in carbon income and the associated net incremental benefit to land owners of converting land to permanent forestry if the permanent forests sequester carbon at half of the expected sequestration rate, modelled in the baseline.

6 **Reduced carbon sequestration (75 per cent)** – this scenario assesses the reduction in carbon income and the associated net incremental benefit to land owners of converting land to permanent forestry if the permanent forests sequester carbon at three-quarters of the expected sequestration rate, modelled in the baseline.

Economic scenarios

7 **High carbon price path –** this scenario assesses the increase in carbon income and the associated net incremental benefit to land owners of converting land to permanent forestry if the carbon price increases linearly to $75 per tonne of CO_2 in 2050, compared to the baseline of $41 per tonne of CO_2 in 2050 modelled in the baseline.

8 **Low carbon price path –** this scenario assesses the reduction in carbon income and the associated net incremental benefit to land owners of converting land to permanent forestry if the carbon price remains at $25 per tonne of CO_2, compared to the baseline linear increase to $41 per tonne of CO_2 in 2050 modelled in the baseline.

9 **Increased activity –** this scenario assesses the impact to the Government and land owners if the conversions to permanent forestry and the activity rate of operational activities are twice those of the baseline.

Following the outline of the scenarios, the report provides a summary of the different scenarios and what they reveal about the Forestry Package's overall impact. The report then concludes.

Scenario analysis

1. Baseline

The baseline scenario assesses the impacts of all policy initiatives proposed by MPI in parts 2 and 3 of the Forestry Package. MPI's impacts and assumptions are described in more detail in Appendix A.

Tables 2 to 4 show the overall Government and land-owner impacts from the two parts. Table 2 shows that the initial cost of the permanent forestry component is $1.2 million, which is borne by the Government.

Table 2. Permanent forestry – Government and land-owner upfront benefits and costs ($)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	-	-
Government costs	-	1,177,484	1,177,484
Net benefits	**-**	**-1,177,484**	**-1,177,484**

Table 3 shows that there is an ongoing net incremental benefit to land owners of $9.7 million from the permanent forestry component of the Forestry Package. This comes with a reduction in ongoing costs to the Government of $29,000 per year from the current costs of $60,000 per year.

Table 3. Permanent forestry – Government and land-owner ongoing benefits and costs ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	9,649,000	9,649,000
Government costs	60,000	30,700	-29,300
Net benefits	**-60,000**	**9,618,300**	**9,678,300**

Table 4 shows that there is an ongoing net incremental benefit to land owners of $28.2 million from the operational changes part of the Forestry Package. This comes with an additional cost to the Government of around $121,000 per year more than the current costs of $126,000 per year.

Table 4. Operational changes – Government and land-owner ongoing benefits and costs ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	3,490,000	31,663,110	28,173,110
Government costs	125,635	246,500	120,865
Net benefits	**3,364,365**	**31,416,610**	**28,052,245**

Permanent forestry impacts

Government impacts

The Government impacts comprise initial and ongoing costs associated with introducing a dedicated "Permanent Post-1989 Forest" activity to the ETS and disestablishing the Permanent Forest Sink Initiative (PFSI). Tables 2 and 3, above, show the upfront and annual costs to the Government of the proposed changes. They show that there is an increase in costs (with the associated benefits for land owners, described below).

Table 2 above, shows the initial impact to the Government is an upfront cost of $1.2 million. Following this, the ongoing cost to the Government is $31,000 per year compared with continuing with the PFSI, which has an ongoing cost of $60,000 per year. Accordingly, the decrease in cost is $29,000 per year, as shown in Table 3.

Land-owner impacts

The impacts to land owners from the permanent forestry component comprise the returns to converting land to permanent forest. These returns are the net incremental benefits of conversion to permanent forests.

As part of the analysis, MPI supplied a scenario of land-use changes as an input to the CBA modelling. The CBA has been undertaken assuming three different types of land-use conversions, including the associated annual rates of conversion and the change in land expectation values (LEVs) that land owners consider according to their own cost-benefit profiles. The land-use change assumptions are as follows:

1 **Retirement of low quality erodible land into native bush** – 40 small land owners (30 hectares each) and three large land owners (110 hectares each) convert to permanent forest each year, and vegetation is regenerated from native seed sources.

2 **Retirement of pine forest on erodible land** – three small land owners and one large land owner with pine forests on erodible land are retired each year and natives are planted.

3 **Planted natives on bare land with mānuka honey income while tall natives establish** – tall natives are planted by 40 small land owners and six large land owners each year, and the land owners make an additional return from honey production.

PwC has not been provided information on any upfront impacts to land owners that arise from the proposed permanent forestry policy change. Any upfront costs are assumed to occur in the year the land owner converts and are incorporated in the change in LEV associated with the land-use conversion. Thus, the upfront costs (including forgone income) are incorporated into the calculation of the LEV.

Table 5 shows the impacts to land owners of the permanent forestry initiative. The total annual net benefit is $9.6 million per year. This is based on 3,590 hectares of land converted to permanent forestry per year in line with the land-use changes outlined above. Note that the net incremental benefit is based on the assumption that there is an instantaneous realisation in the net benefit from an increased the LEV. In calculating the LEV, it is assumed that a land owner retiring a pine forest is forgoing harvest income of $15,000 per hectare when the decision is made to make it a permanent forest.

Table 5. Land-owner impacts from permanent forestry – annual change in net benefit

Impact	Land area converted (Hectares per year)	Change in LEV ($ per hectare)	Expected change ($ per year)
1. *Retirement of erodible land*			
Small land plots (40)	1,200	3,500	4,200,000
Large land plots (3)	330	2,400	792,000
2. Retirement of pine forest			
Small land plots (3)	90	2,500	225,000
Large land plots (1)	110	2,600	286,000
3. Natives with mānuka honey			
Small land plots (40)	1,200	2,300	2,760,000
Large land plots (6)	660	2,100	1,386,000
Totals	**3,590**		**9,649,000**

Notes: (1) The LEVs are calculated based on an eight per cent discount rate.
(2) The LEVs are rounded to the nearest hundred dollars.
(3) The expected changes show the net benefit of the expected policy change from an increase in LEVs. We have not disaggregated the costs and benefits that are included in the calculation of LEVs; only the net benefits have been reported.

Operational change impacts

Government impacts

The operational changes include a mix of improvements for voluntary post-1989 forestry participants, improved voluntary provisions that relate to pre-1990 forest and general improvements for all forestry land

owners. The Government impacts comprise upfront and ongoing costs associated with introducing operational changes into how forestry is managed within the ETS system.

Table 4 on page 7 shows the annual Government impacts from the proposed operational impacts. The policy is expected to cost $247,000 per year, with costs of $126,000 avoided, for a net change of $121,000.

Land-owner impacts

The benefits to land owners of the operational improvements come from making it easier to free up forestry land for other land uses. This has been estimated using the change in LEVs from converting from forestry to dairy, estimated by MPI at $30,000 per hectare. There are additional cost savings that come from freeing up land use. The cost from failing to achieve offsetting reduces from $18,000 per hectare in the status quo to under $2,000 per hectare with the proposed policy change.

Table 6 shows the associated value from freeing up land-use changes and the additional cost savings to land owners. With the assumed conversion rates, these operational changes are expected to have a net incremental benefit to land-owners of $28.1 million per year. We have not been provided information on any upfront impacts to land owners due to the proposed operational improvements.

Table 6. Operational changes – Land-owner ongoing benefits and costs ($ per year)

Impact	Status quo	Proposed policy	Expected change
Benefits	9,000,000	32,842,610	23,842,610
Costs	5,510,000	1,179,500	-4,330,500
Net benefits	**3,490,000**	**31,663,110**	**28,173,110**

Table 6 is based on 800 hectares per year (700 hectares from improving the pre-1990 offsetting and 100 hectares from allowing the trustees and agents for multiple-owned land to complete the application) compared to 300 hectares per year.

The costs in the status quo consist of:

- the current process for pre-1990 offsetting at a cost of $18,000 per hectare for around 300 hectares per year
- considering deforested exempt land that becomes forest land nine years or more after being post-1989 forest land at $26,000 per hectare for 10 hectares per year.

The costs expected to be incurred by land owners under the operational changes are:

- from improving the process for offsetting, there is estimated to be 700 hectares per year at $2,000 per hectare
- from making 150 notifications per year of interested parties when land is added or removed at $50 per application
- from a new process for carbon accounting areas that will impact 1,000 hectares per year at $122 per hectare.

2. Different policy package

In this scenario, the minor and technical policy changes are removed from the operational changes policy. The package of changes was adjusted to reflect the emerging policy development concerning averaging, and the timing of decisions, which was different from the baseline CBA. The main changes include the Government not:

- undertaking 17 site visits per year to approve deforestation of post-1989 forests ($60,000 per year)
- administering the extension section 60 to include post-1989 forests, with three applications per year ($50,000 per year)

- employing half a full-time equivalent (FTE) to administer the new process for Carbon Accounting Areas (CAAs) ($50,000 per year).

Removing the minor and technical policies changes reduces the ongoing costs to the Government by $160,000 per year. Table 7 shows the ongoing benefits and costs associated with this version of the proposed policy change. The Government costs under the proposed policy is $87,000 per year, representing a saving of nearly $39,000 per year.

Table 7. Operational changes – Government and land-owner ongoing benefits and costs, with a different policy package ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	3,490,000	31,675,000	28,185,000
Government costs	125,635	87,000	-38,635
Net benefits	**3,364,365**	**31,416,610**	**28,223,635**

There are minor changes to the net benefits profile for land owners, which increases the net benefits of freeing up land use by just below $12,000 per year compared with the baseline scenario. This includes not realising benefits totalling $118,000, made up of:

- simplifying transfers of post-1989 forest land (eight land parcels totalling $52,000 per year)
- not requiring land owners to complete an emissions return when they face a natural disturbance event (five emissions returns totalling $610 per year)
- allowing optional transfer of participation when a forestry right is granted (ten land parcels totalling $65,000 per year)

and avoiding the costs totalling $130,000, made up of:

- notifying interested parties when land is added or removed (150 notifications totalling $8,000 per year)
- reconfiguring CAAs (1,000 hectares totalling $122,000 per year).

At the assumed activity rates, the benefits to land owners without these minor and technical policies remains more than the costs. Table 8 shows the change in LEVs and additional land-owner costs associated with removing the minor and technical operational policies.

Table 8. Operational changes – Land-owner ongoing benefits and costs ($ per year)

Impact	Status quo	Proposed policy	Expected change
Benefits	9,000,000	32,725,000	23,725,000
Costs	5,510,000	1,050,000	-4,460,000
Net benefits	**3,490,000**	**31,675,000**	**28,185,000**

3. Status quo behaviour

We may not observe significant rates of uptake in the future. Even without significant uptake, a net incremental benefit of $4.8 million per year can be realised by land owners. By improving the process for pre-1990 offsetting, a significant cost of converting from permanent forestry to another land use is expected to decrease by $16,000 per hectare.

Tables 9 and 10 show that the reduction in costs, which impacts 300 hectares per year, creates a net incremental benefit of $4.8 million per year.

Table 9. Operational changes – Status quo behaviour Land-owner ongoing benefits and costs ($ per year)

Impact	Status quo	Proposed policy	Expected change
Benefits	9,000,000	9,000,000	-
Costs	5,510,000	710,000	(4,800,000)
Net benefits	**3,490,000**	**8,290,000**	**4,800,000**

Table 10 also shows that the ongoing costs to the Government are the same as the status quo. This is because, under this scenario, the activity rates and the cost per activity are the same for the status quo and the proposed policy.

Table 10. Operational changes – Status quo behaviour Government and land-owner ongoing benefits and costs ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	3,490,000	8,290,000	4,800,000
Government costs	125,635	125,635	-
Net benefits	**3,364,365**	**8,164,365**	**4,800,000**

4. Six per cent discount rate

A decrease in the discount rate will increase the land expectation values, because the opportunity cost of capital is lower. Table 11 shows MPI's land expectation values based on both an eight per cent discount rate (baseline – see Table 5) and six per cent discount rate, as well as the difference between them.

Table 11. Difference in LEVs – Eight and six per cent discount rates

Land-use change	Baseline 8% discount rate ($ per hectare)	6% discount rate ($ per hectare)	Difference ($ per hectare)
1. *Retirement of erodible land*			
Small land plots	3,500	5,100	1,600
Large land plots	2,400	3,600	1,200
2. Retirement of pine forest			
Small land plots	2,500	8,900	5,400
Large land plots	2,600	9,000	6,400
3. Natives with mānuka honey			
Small land plots	2,300	4,800	2,500
Large land plots	2,100	4,500	2,400

Table 12 shows the impacts to land owners of the permanent forestry initiative based on a six per cent discount rate. The total net benefit is $17.8 million per year, which is an $8.2 million increase from the baseline of $9.6 million per year. This is based on 3,590 hectares being converted to permanent forestry per year in line with the land-use changes outlined above.

Table 12. Land-owner impacts from permanent forestry with a six per cent discount rate – annual change in net benefit

Impact	Land area converted (Hectares per year)	Change in LEV ($ per hectare)	Expected change ($ per year)
1. *Retirement of erodible land*			
Small land plots (40)	1,200	5,100	6,120,000
Large land plots (3)	330	3,600	1,188,000
2. Retirement of pine forest			
Small land plots (3)	90	8,900	801,000
Large land plots (1)	110	9,000	990,000
3. Natives with mānuka honey			
Small land plots (40)	1,200	4,800	5,760,000
Large land plots (6)	660	4,500	2,970,000
Totals	**3,590**		**17,829,000**

Note: The expected changes show the net benefit of the expected policy change from an increase in LEVs. We have not disaggregated the costs and benefits that are included in the calculation of LEVs and only the net benefits have been reported.

Table 13 shows that there is an ongoing net incremental benefit to land owners of $17.9 million from the permanent forestry component of the Forestry Package, with a six per cent discount rate. This comes with the equivalent reduction in ongoing costs to the Government of $29,000 per year, as with the baseline scenario.

Table 13. Permanent forestry –Government and land-owner ongoing benefits and costs with a six per cent discount rate ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	17,829,000	17,829,000
Government costs	60,000	30,700	-29,300
Net benefits	**-60,000**	**17,798,300**	**17,858,300**

5. Reduced sequestration 1

In this scenario, carbon is sequestered by trees at a rate of 50 per cent in later years, for which MPI has estimated the carbon sequestration rates in the absence of published yield information. This includes sequestration rates for the following land-use changes:

1 **Retirement of low quality erodible land into native bush** –1.1 tonnes of carbon per hectare per year sequestered from years 51 to 100 is halved to 0.65 tonnes of carbon per hectare per year.

2 **Retirement of pine forest on erodible land** – 20 tonnes of carbon per hectare per year sequestered from years 51 to 100 is halved to 10 tonnes of carbon per hectare per year.

3 **Planted natives on bare land with mānuka honey income while tall natives establish** – eight tonnes of carbon per hectare per year sequestered from years 32 to 100 is halved to four tonnes of carbon per hectare per year.

Reduced sequestration will decrease carbon income from permanent forestry in later years, decrease the land expectation values and make permanent forestry less attractive, all else equal. Table 14 shows MPI's land expectation values for the baseline scenario and for the sequestration reduced by 50 per cent.

Table 14. Difference in LEVs – carbon sequestration reduced to 50 per cent

Land-use change	Baseline ($ per hectare)	50% sequestration ($ per hectare)	Difference ($ per hectare)
1. *Retirement of erodible land*			
Small land plots	3,500	3,500	-
Large land plots	2,400	2,400	-
2. Retirement of pine forest			
Small land plots	2,500	1,400	-1,100
Large land plots	2,600	1,500	-1,100
3. Natives with mānuka honey			
Small land plots	2,300	2,000	-300
Large land plots	2,100	1,800	-300

Table 15 shows the impacts to land owners of the permanent forestry initiative based on a six per cent discount rate. The total net benefit is $8.9 million per year, which is a $778,000 decrease from the baseline of $9.6 million per year.

Table 15. Land-owner impacts from permanent forestry with carbon sequestration reduced to 50 per cent – annual change in net benefit

Impact	Land area converted (Hectares per year)	Change in LEV ($ per hectare)	Expected change ($ per year)
1. *Retirement of erodible land*			
Small land plots (40)	1,200	3,500	4,200,000
Large land plots (3)	330	2,400	792,000
2. Retirement of pine forest			
Small land plots (3)	90	1,400	126,000
Large land plots (1)	110	1,500	165,000
3. Natives with mānuka honey			
Small land plots (40)	1,200	2,000	2,400,000
Large land plots (6)	660	1,800	1,188,000
Totals	**3,590**		**8,871,000**

Note: The expected changes show the net benefit of the expected policy change from an increase in LEVs. We have not disaggregated the costs and benefits that are included in the calculation of LEVs and only the net benefits have been reported.

Table 16 shows that there is an ongoing net incremental benefit to land owners of $8.9 million from the permanent forestry component of the Forestry Package, with a reduction in carbon sequestration to 50 per cent of the baseline. This comes with the equivalent reduction in ongoing costs to the Government of $29,000 per year, as with the baseline scenario.

Table 16. Permanent forestry – Government and land-owner ongoing benefits and costs with carbon sequestration reduced to 50 per cent ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	8,871,000	8,871,000
Government costs	60,000	30,700	-29,300
Net benefits	**-60,000**	**8,840,300**	**8,900,300**

6. Reduced sequestration 2

In this scenario, carbon is sequestered by trees at a rate of 75 per cent of the baseline case in later years, for which MPI has estimated the carbon sequestration rates in the absence of published yield information. This includes sequestration rates for the following land-use changes:

1 **Retirement of low quality erodible land into native bush** –1.1 tonnes of carbon per hectare per year sequestered from years 51 to 100 is reduced to 0.83 tonnes of carbon per hectare per year.

2 **Retirement of pine forest on erodible land** – 20 tonnes of carbon per hectare per year sequestered from years 51 to 100 is reduced to 15 tonnes of carbon per hectare per year.

3 **Planted natives on bare land with mānuka honey income while tall natives establish** – eight tonnes of carbon per hectare per year sequestered from years 32 to 100 is reduced to six tonnes of carbon per hectare per year.

Table 17 shows MPI's land expectation values for the baseline scenario and for the sequestration reduced to 75 per cent of baseline rates in later years.

Table 17. Difference in LEVs – carbon sequestration reduced to 75 per cent

Land-use change	Baseline ($ per hectare)	75% sequestration ($ per hectare)	Difference ($ per hectare)
1. *Retirement of erodible land*			
Small land plots	3,500	3,500	-
Large land plots	2,400	2,400	-
2. Retirement of pine forest			
Small land plots	2,500	2,000	-500
Large land plots	2,600	2,100	-500
3. Natives with mānuka honey			
Small land plots	2,300	2,200	-100
Large land plots	2,100	2,000	-100

Table 18 shows the impacts to land owners of the permanent forestry initiative based reduced sequestration to 75 per cent. The total net benefit is $9.4 million per year, which is a $286,000 decrease from the baseline of $9.6 million per year.

Table 18. Land-owner impacts from permanent forestry with carbon sequestration reduced to 75 per cent – annual change in net benefit

Impact	Land area converted (Hectares per year)	Change in LEV ($ per hectare)	Expected change ($ per year)
1. *Retirement of erodible land*			
Small land plots (40)	1,200	3,500	4,200,000
Large land plots (3)	330	2,400	792,000
2. Retirement of pine forest			
Small land plots (3)	90	2,000	180,000
Large land plots (1)	110	2,100	231,000
3. Natives with mānuka honey			
Small land plots (40)	1,200	2,200	2,640,000
Large land plots (6)	660	2,000	1,320,000
Totals	**3,590**		**9,363,000**

Note: The expected changes show the net benefit of the expected policy change from an increase in LEVs. We have not disaggregated the costs and benefits that are included in the calculation of LEVs and only the net benefits have been reported.

Table 19 shows that there is an ongoing net incremental benefit to land owners of $9.4 million from the permanent forestry component of the Forestry Package, with a reduction in carbon sequestration to 75 per cent of the baseline. This comes with the equivalent reduction in ongoing costs to the Government of $29,000 per year, as with the baseline scenario.

Table 19. Permanent forestry – Government and land-owner ongoing benefits and costs with carbon sequestration reduced to 75 per cent ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	9,363,000	9,363,000
Government costs	60,000	30,700	-29,300
Net benefits	**-60,000**	**9,332,300**	**9,392,300**

7. High carbon price path

In this scenario, the carbon price reaches a high price path to $75 per tonne of CO_2 in 2050. This price path is based on the Productivity Commission's finding that the price will need to rise to at least $75 per tonne to achieve 2050 emissions-reduction targets.[1] A high price path results in higher LEVs for all permanent forest land types and more carbon income from converting to permanent forests than the baseline. Table 20 shows MPI's LEVs for the baseline scenario ($41 per tonne of CO_2 in 2050) and for the high price path ($75 per tonne of CO_2 in 2050, assuming a linear pattern of increase).

Table 20. Difference in LEVs – High price path to $75 in 2050

Land-use change	Baseline ($ per hectare)	$75 price path ($ per hectare)	Difference ($ per hectare)
1. *Retirement of erodible land*			
Small land plots	3,500	5,000	1,500
Large land plots	2,400	3,500	1,100
2. Retirement of pine forest			
Small land plots	2,500	7,500	5,000
Large land plots	2,600	7,600	5,000
3. Natives with mānuka honey			
Small land plots	2,300	3,800	1,500
Large land plots	2,100	3,600	1,500

Table 21 shows the impacts to land owners of the permanent forestry initiative based on the high carbon price path. The total net benefit is $15.6 million per year, which is a $6.0 million increase from the baseline of $9.6 million per year

Table 21. Land-owner impacts from permanent forestry with a high price path to $75 in 2050 – annual change in net benefit

Impact	Land area converted (Hectares per year)	Change in LEV ($ per hectare)	Expected change ($ per year)
1. *Retirement of erodible land*			
Small land plots (40)	1,200	5,000	6,000,000
Large land plots (3)	330	3,500	1,155,000
2. Retirement of pine forest			
Small land plots (3)	90	7,500	675,000
Large land plots (1)	110	7,600	836,0000
3. Natives with mānuka honey			
Small land plots (40)	1,200	3,800	4,560,000
Large land plots (6)	660	3,600	2,376,000
Totals	**3,590**		**15,602,000**

Note: The expected changes show the net benefit of the expected policy change from an increase in LEVs. We have not disaggregated the costs and benefits that are included in the calculation of LEVs and only the net benefits have been reported.

[1] New Zealand Productivity Commission. (2018). Low-emissions economy: Final report. Available from www.productivity.govt.nz/low-emissions

Table 22 shows that there is an ongoing net incremental benefit to land owners of $15.6 million from the permanent forestry component of the Forestry Package, under a high carbon price path scenario. This comes with the equivalent reduction in ongoing costs to the Government of $29,000 per year, as with the baseline scenario.

Table 22. Permanent forestry – Government and land-owner ongoing benefits and costs with a high price path to $75 in 2050 ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	15,602,000	15,602,000
Government costs	60,000	30,700	-29,300
Net benefits	**-60,000**	**15,571,300**	**15,631,300**

8. Low carbon price path

In this scenario, the carbon price remains at $25 per tonne of CO_2. This results in lower LEVs for all permanent forest land types and less carbon income from permanent forests compared with the baseline. Table 23 shows MPI's LEVs for the baseline scenario ($41 per tonne of CO_2 in 2050) and for the low price path ($25 per tonne of CO_2 in 2050).

Table 23. Difference in LEVs – Low price path at $25 per tonne of CO_2

Land-use change	Baseline ($ per hectare)	$25 carbon price ($ per hectare)	Difference ($ per hectare)
1. *Retirement of erodible land*			
Small land plots	3,500	1,800	-1,700
Large land plots	2,400	1,100	-1,700
2. Retirement of pine forest			
Small land plots	2,500	-4,100	-6,600
Large land plots	2,600	-3,900	-6,500
3. Natives with mānuka honey			
Small land plots	2,300	700	-1,600
Large land plots	2,100	500	-1,600

Throughout the CBA, it is assumed that the land owners that retire pine forests are forgoing harvesting income of $15,000 per hectare when the decision is made to establish a permanent forest. When the carbon price is held constant at $25 per tonne of CO_2, retiring pine forests results in a negative LEVs, due to the forgone harvest income.

Table 24 shows the impacts to land owners of the permanent forestry initiative based on a low carbon price path. The total net benefit is $2.9 million per year, which is a $6.8 million less than the baseline of $9.6 million per year.

Table 24. Land-owner impacts from permanent forestry with a low price path at $25 in 2050 – annual change in net benefit

Impact	Land area converted (Hectares per year)	Change in LEV ($ per hectare)	Expected change ($ per year)
1. *Retirement of erodible land*			
Small land plots (40)	1,200	1,800	2,160,000
Large land plots (3)	330	1,100	363,000
2. Retirement of pine forest			
Small land plots (3)	90	-4,100	-369,000
Large land plots (1)	110	-3,900	-429,000
3. Natives with mānuka honey			
Small land plots (40)	1,200	700	840,000
Large land plots (6)	660	500	330,000
Totals	**3,590**		**2,895,000**

Note: The expected changes show the net benefit of the expected policy change from an increase in LEVs. We have not disaggregated the costs and benefits that are included in the calculation of LEVs and only the net benefits have been reported.

If a pine forest was unsuitable for harvest (for example because the land is excessively steep and a health and safety hazard), the forgone harvesting income can be ignored. This would result in land expectations values of around $11,000 per hectare for small and large permanent pine forests. If these values were used in the CBA, the benefits of the permanent forest activity would increase by $3 million per year.

Table 25 shows that there is an ongoing net incremental benefit to land owners of $2.9 million from the permanent forestry component of the Forestry Package, with a low carbon price path. This comes with the equivalent reduction in ongoing costs to the Government of $29,000 per year, as with the baseline scenario.

Table 25. Permanent forestry – Government and land-owner ongoing benefits and costs with a low price path at $25 in 2050 ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	2,895,000	2,895,000
Government costs	60,000	30,700	-29,300
Net benefits	**-60,000**	**2,864,300**	**2,924,300**

9. Increased activity

The last scenario shows the impacts from double the quantity of activity for the operational improvements and permanent forestry components of the Forestry Package.

Table 26 shows the impacts to land owners of the permanent forestry initiative based on double the amount of land conversions each year. The total net benefit of $19.3 million per year is double the total net benefit of the baseline.

Table 26. Land-owner impacts from permanent forestry with twice the annual conversion to permanent forestry – annual change in net benefit

Impact	Land area converted (Hectares per year)	Change in LEV ($ per hectare)	Expected change ($ per year)
1. *Retirement of erodible land*			
Small land plots (80)	2,400	3,500	8,400,000
Large land plots (6)	660	2,400	1,584,000
2. Retirement of pine forest			
Small land plots (6)	180	2,500	450,000
Large land plots (2)	220	2,600	572,000
3. Natives with mānuka honey			
Small land plots (80)	2,400	2,300	5,520,000
Large land plots (12)	1,320	2,100	2,772,000
Totals	**7,180**		**19,298,000**

Note: The expected changes show the net benefit of the expected policy change from an increase in LEVs. We have not disaggregated the costs and benefits that are included in the calculation of LEVs and only the net benefits have been reported.

Table 27 shows that there is an ongoing net incremental benefit to land owners of $19.3 million from the permanent forestry component of the Forestry Package, with double the amount of activity of the baseline. This comes with an incremental increase in ongoing costs to the Government of $1,000 per year from managing that permanent forestry activity.

Table 27. Permanent forestry – Government and land-owner ongoing benefits and costs with twice the activity ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	-	19,298,000	19,298,000
Government costs	60,000	61,400	1,400
Net benefits	**-60,000**	**19,236,600**	**19,296,600**

In this scenario the activity for pre-1990 offsetting, simplified transfers and optional participation are doubled. Table 28 shows that there is an ongoing net incremental benefit to land owners of $48.2 million from the operational changes part of the Forestry Package. This comes with an additional cost to the Government of around $121,000 per year more than the current costs of $126,000 per year.

Table 28. Operational changes with twice the activity – Government and land-owner ongoing benefits and costs ($ per year)

Impact	Status quo	Proposed policy	Expected change
Land-owner net benefits	3,490,000	51,730,110	48,240,110
Government costs	125,635	246,500	120,865
Net benefits	**3,364,365**	**51,483,610**	**48,119,245**

Summary of results

Table 29 on the following page shows, for reference, the impacts to the Government and land owners under each scenario and the differences from the baseline.

The above results show that land-use decisions are affected by policy. The operational improvements in particular promote flexibility in land-use choice which provides value to land owners. In this CBA, land owners get significant value from the operational improvements to the ETS, and marginally more net benefit without minor and technical operational changes (scenario 2).

We may not observe significant rates of uptake in the future. Even without significant uptake, a net incremental benefit of $4.8 million per year can be realised by land owners. By improving the process for pre-1990 offsetting, the cost of converting from permanent forestry to another land use is expected to reduce by $16,000 per hectare.

Scenarios 4 to 9 show that the proposed policy change is not the only driver of value for forestry participants. The net benefits of the policy are sensitive (but not equally sensitive) to the:

- opportunity cost of investing in permanent forestry (scenario 4)
- amount of carbon sequestered by forests (scenarios 5 and 6)
- carbon price path (scenarios 7 and 8)
- uptake of permanent forestry into the programme (scenario 9).

The land owners' net incremental benefits appear to be most sensitive to the carbon price and the opportunity cost of capital. LEVs and net benefits are less sensitive to the carbon sequestration rate in later years, as the reduced income is discounted more heavily so contributing less to the LEV.

Note that we have modelled the comparative difference between a scenario and the baseline, but have not undertaken an assessment of the interaction between any two scenarios. Most of the scenarios are not mutually exclusive and the impact of more than one scenario could be realised following the policy shift. For example, high price path and double activity could occur together, resulting in larger net incremental benefits to land owners than either of the scenarios by itself.

Table 29. Government and land-owner ongoing impacts under each scenario ($ per year, nominal)

	Permanent forestry		Operational changes	
Scenarios	**Proposed policy**	**Difference from baseline**	**Proposed policy**	**Difference from baseline**
1. Baseline				
Land-owner net benefits	9,649,000		31,663,110	
Government costs	30,700		246,500	
2. Different policy packages				
Land-owner net benefits	9,649,000	-	31,675,000	11,890
Government costs	30,700	-	87,000	-159,500
3. Status quo behaviour				
Land-owner net benefits	9,649,000	-	8,290,000	-23,373,110
Government costs	30,700	-	125,635	-120,865
4. Six per cent discount rate				
Land-owner net benefits	17,829,000	8,180,000	31,663,110	-
Government costs	30,700	-	246,500	-
5. Reduced sequestration 1				
Land-owner net benefits	8,871,000	-778,000	31,663,110	-
Government costs	30,700	-	246,500	-
6. Reduced sequestration 2				
Land-owner net benefits	9,363,000	-286,000	31,663,110	-
Government costs	30,700	-	246,500	-
7. High carbon price path				
Land-owner net benefits	15,602,000	5,953,000	31,663,110	-
Government costs	30,700	-	246,500	-
8. Low carbon price path				
Land-owner net benefits	2,895,000	-6,754,000	31,663,110	-
Government costs	30,700	-	246,500	-
9. Increased activity				
Land-owner net benefits	19,298,000	9,649,000	51,730,110	20,067,000
Government costs	61,400	30,700	246,500	-

Conclusion

This report provides analysis of scenarios of the proposed policy initiative and other key variables that underpin the cost borne by the Government and the net benefits realised by land owners due to proposed changes to the ETS through the Forestry Package. The scenario analysis includes a baseline assessment and eight further scenarios.

The baseline results show that there is a larger upfront cost, borne by the Government, and a comparatively smaller ongoing cost to the Government. Land owners receive benefits from the changes, and those benefits are substantially larger than the costs to the Government.

The scenarios investigated the role of:

- minor and technical operational changes in the Forestry Package
- the reduction, by the Forestry Package, of the cost of offsetting
- the opportunity cost of land owners of investing in permanent forestry
- the amount of carbon that MPI estimates forests will sequester in later years
- the carbon price path
- the uptake of permanent forestry into the programme.

The overall profile of costs and benefits does not change across all the scenarios modelled, but the magnitude of the impacts change.

The costs and benefits are affected by policy. The operational changes have the largest impact as they free up current constraints on land-use conversion. However, the impacts are also affected by non-policy inputs and the magnitude of some benefits are substantially independent of the policy. The magnitude of benefits are impacted by market forces, including the carbon price path and opportunity cost of establishing a permanent forest. Less important is the amount of carbon sequestered in later years, of which published yield tables do not exist.

The uptake rates are directly and linearly related to the benefits: more uptake produces more benefits, while less update produces less, in the same proportion.

The scenarios that were less favourable compared to the baseline were a continuation of status quo policy setting and consequential behaviour, and a low carbon price path. In the former, the policy would have failed to produce any change to land-owner behaviours. The latter is outside the control of the Ministry.

Appendix A – Key baseline assumptions

Table 30 outlines the baseline assumptions that underpin the calculations of impacts in this CBA.

Table 30. Assumptions underpinning cost-benefit analysis

Assumption	Value	Description	Source
Discount rate for investment	• Eight percent (nominal)	A series of surveys report post-tax implied discount rates of between 7% and 9% and pre-tax IDRs of 7% and 9% are typically used by the timber industry	Published in the New Zealand Journal of Forestry. For example, Manley, 2018, Discount rates used for forest valuation - Results of 2017 survey, New Zealand Journal of Forestry, 63(2), pages 35–43
ETS registration costs	• $650 per registration	Slightly above the current cost of registering forest (c.$570) to account for the variable hour charge	MPI estimate, provided in 'Scenarios for permanent forest and operational improvements CBA report'
ETS emissions return	• $122 per return	The cost of filing an emissions return is $122	MPI estimate, provided in 'Scenarios for permanent forest and operational improvements CBA report'
Mānuka honey revenue.	• $345 per hectare per year in years 3 to 15 • $120 per hectare per year in years 16 to 22	In years 3 to 15, income from honey production is estimated to return 25 per cent of honey value to land owner, 23 kg per hive (hectare) and $60 per kg of honey. In years 16 to 22, honey return is assumed to be 8 kg per hectare	MPI estimate, provided in 'Scenarios for permanent forest and operational improvements CBA report'
Costs of land use 1	• $0 per hectare per year	The land being registered as a forest is put into forest for other reasons (eg stock exclusion) and naturally reverts	MPI estimate, provided in 'Scenarios for permanent forest and operational improvements CBA report'
Cost of land use 2	• $15,000 per hectare	If the land owner for land use 2 is forgoing harvest they do not receive the net income to the land owner from not harvesting pine forest. This is based on the stumpage of either low quality sites or those with high harvest costs	MPI estimate, provided in 'Scenarios for permanent forest and operational improvements CBA report'
Costs of land use 3	• $3,010 upfront cost of establishment • $1,000 in year 23 to establish tall species. • per hectare	The upfront cost is that to establish the mānuka plantation. The cost of $1,000 per hectare is to establish the tall species	MPI estimate, provided in 'Scenarios for permanent forest and operational improvements CBA report'

Appendix B – Scenario assumptions

Land expectation values

MPI uses a discounted cash flow approach to evaluate the benefits for permanent forest. This approach implies that land owners receives the full benefit from future cash flows (through an uplift in land expectation value) when the decision is made to register as a permanent post-1989 forest. However, each parcel of land only receives this benefit once (in the year it becomes permanent post-1989 forest).

This approach allows easy testing of the assumptions that underpin the model and undertaking of sensitivity analysis.

Annual uptake of permanent post-1989 forests

MPI has provide three different types of land-use conversions, including the associated annual rates of conversion and the change in LEVs. The MPI's land-use assumptions are as follows:

1 **Retirement of low quality erodible land into native bush** – 40 small land owners (30 hectares each) and three large land owners (110 hectares each) convert to permanent forest each year, and vegetation is regenerated from native seed sources. The land area converted is 1,530 hectares per year.

2 **Retirement of pine forest on erodible land** – three small land owners and one large land owner with pine forests on erodible land are retired each year and natives are planted. The land area converted is 200 hectares per year.

3 **Planted natives on bare land with mānuka honey income while tall natives establish** – tall natives are planted by 40 small land owners and six large land owners each year, and the land owners make an additional return from honey production. The land area converted is 1,860 hectares per year.

The total land area converted is 3,590 hectares per year. This conversion rate is very close to the average annual registration in the ETS of 3,667 hectares of indigenous forests (33,000 hecatres after nine years). Estimating pine forest where the land owner will elect to forgo harvest (land-use change 2) is speculative and MPI assumes 200 hectares per year (0.5% of the annual harvest area)

Carbon sequestration

MPI's carbon sequestration modelling used as an input to the CBA scenarios is based on the areas registered in the ETS in September 2018. MPI developed area-weighted tables based on:

- the default yield tables for forests with an area of less than 100 hectares
- 10 years of field measurement data for forests with an area of 100 hectares or greater that use the 'Field Measurement Approach' (FMA) to determine carbon stock.

Published yield tables only cover a 50-year time horizon. To estimate the yield tables beyond age 50, MPI assumes:

- for the first land use, that 1.1 tonnes of carbon per hectare per year is sequestered by native forests – 60 per cent of the stock change between ages 40 and 50)
- for the second land use, that 20 tonnes per hectare per year of carbon is sequestered – 84 per cent of the stock change between ages 40 and 50)

- for the third land use, replacement of native forest (mānuka) by tall native species has a material increase in the carbon stock 10 years after planting (from year 30). Once tall native forest establishes, MPI assumes it has a comparable rate of sequestration to that observed across a range of native species.[2] It is also equivalent to the sequestration seen in the FMA forests between ages 10 and 24. It is assumed that small forests (under 100 hectares) will sequester eight tonnes per hectare per year, while FMA forests sequester 10 tonnes per hectare per year.

Following this, three carbon-sequestration scenarios are undertaken:

- the scenario as described above for the baseline
- the projected carbon stock change is 50% of the above (eg pine forests sequester 10 tonnes per hectare per year after age 50)
- the projected carbon stock change is 75% of the baseline.

Carbon price path

MPI assumes that the carbon price increase linearly to a nominal price of $75 per tonne of CO_2 in 2050.

This provides a useful lower estimate of the carbon price in 2050. There is increasing evidence that, for the world to deliver on the Paris Agreement's objectives of stabilising temperature, both the global and domestic carbon prices must increase. For example the Productivity Commission provides contrasting scenarios where the real 2050 carbon prices are between $75 and $250.

MPI models LEVs using three scenarios of the carbon price path, all of which increase linearly:

- a baseline price path based on a real price of $41 per tonne of CO_2 in 2050 (based on a nominal price of $75 per tonne)
- a high price path based on a real price of $75 per tonne of CO_2 in 2050 real terms (a corresponding nominal price of $137 per tonne of carbon)
- a low price path based on a nominal price of $25 per tonne of CO_2 in all years.

All prices increase linearly from the current price ($25 per tonne of CO_2) to the 2050 price, and remain at that price after 2050.

[2] Carbon Sequestration by Planted Native Trees and Shrubs, available at www.tanestrees.org.nz

Appendix C – Restrictions

This report has been prepared by PricewaterhouseCoopers Consulting (New Zealand) LP (PwC) solely for the Ministry for Primary Industries (MPI) for the purposes stated herein and should not be relied upon for any other purpose. PwC accepts no liability to any party should the report be used for any purpose other than that for which it was prepared.

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The statements and opinions expressed in this report are based on information available as at the date of the report.

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This report is issued pursuant to the terms and conditions set out in the Consultancy Services Order between PwC and MPI signed 7 November 2018.

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